

**MAHATMA GANDHI UNIVERSITY**  
**Ph.D. Course Work - Mathematics**  
**Course II – Modern Trends in Mathematics**

**UNIT-I**

**Topology and Modern Analysis**

Elements of Set Theory, Countable and uncountable sets, cardinal numbers, Cantor's theorem, Partially ordered set, Axiom of choice, Zorn's lemma, Metric spaces, Open ball and open sets, Topological spaces, Bases, Sub-base, Metric topology, Continuous function and Compact spaces.

**UNIT-II**

**Real and Complex Analysis**

Sequence and series, Limits, Differentiability, Riemann Integral, Algebra of complex numbers, Power series, Analytic functions, Taylor and Laurent series, Conformal mappings, Integration in complex plane, Fundamental theorem of algebra, Maximum modulus theorem.

**UNIT-III**

**Algebra and Discrete Mathematics**

Groups, Subgroups, Normal subgroups, Homomorphism, Vector spaces, Subspaces, Base, Linear Transformations, Algebra of matrices, Eigen values and eigen vectors  
Graph theory: Eulerian and Hamiltonian graph, planar graph, Directed graph, Spanning tree.

**UNIT-IV**

**Differential and Difference Equations**

First order ordinary differential equations, Singular solutions, Initial value problem of first order ODE, General theory of homogeneous and non-homogeneous linear ODE, Fundamental matrices, Elementary PDE, Equations solvable by direct integration, non-linear equations of first order, Charpits method, Difference equations, Definition, Order, linear difference equations, Existence and uniqueness theorem, Solution of the equation, General solution of the homogeneous and non-homogeneous difference equations.

**UNIT-V**

**Measure and Probability**

$\sigma$  Algebra, Measurable sets (events), Definition of measure and probability, Measure space and probability space, measurable function and random variable, integral of a measurable function and expectation of a random variable, Properties of integral (expectation),

**Reference Books:**

**Unit-I & Unit-II :**

1. J.B. Conway: Functions of one complex variable, Springer-Verlag.
2. George F Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
3. R. Goldberg: Methods of Real Analysis, New Age International Ltd.
4. Robert G. Bartle and Donald R. Sherbert: Introduction to Real analysis, John Willey and Sons.

5. S.Ponnusamy: Foundation of Complex Analysis, Narosa Publishing Ltd.
6. Savita Arora and S.C. Malik: Advanced Analysis, New Age International Ltd.

### **Unit-III**

1. Douglas B West, Introduction to Graph Theory, Prentice hall of India.
2. J.B. Fraleigh: A First course in Abstract Algebra, Narosa publishing House.
3. F.Harrary, Graph Theory, Adisson-Wesley, 1969.
4. I.N.Herstein: Topics in Algebra, Wiley- Eastern.
5. John Clark and Derek Allan Holtan, A First Look at Graph Theory, Allied publishers.
6. Kennath Hoffman/ Ray Kunze, Linear algebra, Prentice-Hall of India, Pvt. Ltd., Deli, 1992.

### **Unit-IV**

1. George F.Simmons, Differential Equation with Applications and Historical Notes, Tata Mc.Graw Hill.
2. Ian Sneddon, Elements of Partial differential Equations, Mc.Graw Hill Book Company.
3. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 2001.
4. Phoolan Prasad and Renuka Ravindran, Partial Differential Equations, New Age International Publications, Ne2w Delhi, 2005.

### **Unit-V**

1. G. de. Barra, Measure Theory And Integration, New Age International Publishers
2. Walter Rudin, Real and Complex Analysis, McGraw Hill, New York, 1966.
3. B.R. Bhat, Modern Probability Theory, New Age International (P) Ltd., Publishers.
4. Sidney I. Resnick, A Probability Path, Birkhauser, 1998.